

REMARKS/ARGUMENTS

Claims 1-8 have been canceled. New Claims 9-18 are active in the case.

Reconsideration is respectfully requested.

The present invention relates to (meth)acrylic acid copolymers for use in water treatment, scale inhibition in petroleum production and corrosion inhibition.

Specification Amendments

The specification has been amended in order to introduce therein appropriate section headings. Entry of the amendments is respectfully requested.

Claim Amendments

Claim 4 has been amended in the form of new Claim 14 by specifying that the sulfoalkylamide structural units of the (meth)acrylic acid copolymer are randomly distributed in the copolymer. Support for this amendment can be found in the discussion on page 8, lines 6-20 of the specification.

Minor amendments have been made to Claims 2-8 in the form of new Claims 10, 11, 14-18. New Claims 12 and 13 are supported by the text at page 3, lines 27-30 and page 4, lines 35-37 of the text. Entry of the amendments and new claims is respectfully requested.

Invention

Applicants emphasize that in step (1) of the present process, (meth)acrylic acid monomer(s) is subjected to free-radically initiated polymerization which results in a polymer (I) that is subsequently amidated with at least one aminoalkylsulfonic acid. In the present process the free-radical initiated polymerization materially affects the distribution of sulfoalkylamide units in the polymer molecules. Polymers that are prepared by a polymer-

analogous means can differ markedly from polymers which are obtained by free radical copolymerization of acrylamide with acrylic acid and subsequent transamidation of the amide units with aminoalkylsulfonic acid. Also, free-radical copolymerization generally results in other structures. In the last reaction mentioned, the distribution of the sulfoalkylamide units is predetermined by the copolymerization parameters of the monomers used in the free-radical copolymerization. The result is that the statistical distribution of different functional groups on the polymer backbone in the case of polymers that are synthesized by polymer-analogous means is generally different than when corresponding groups are introduced by free-radical copolymerization.

Polymers synthesized by polymer-analogous means differ markedly from polymer prepared by free-radical polymerization of acrylamide monomer with acrylic acid followed by transamidation of the amide units in the polymer with aminoethanesulofonic acid. In the free-radical case, the distribution of the sulfoethylamide units is predetermined by the copolymerization parameters of the monomers used in the free-radical copolymerization. The result is that the distribution of different functional groups on the polymer backbone is significantly different in free-radical induced polymerization compared to copolymerization by polymer-analogous means of introduction of corresponding groups into previously synthesized polymers.

Claim Rejection, 35 USC 103

Claims 4 and 5 stand rejected based on 35 USC 102(b) as anticipated by Fong et al, U. S. Patent 4,604,431. This ground of rejection is respectfully traversed.

Fong et al discloses a method of preparing copolymers of acrylamidosulfonic acids in which acrylamidosulfonic groups. In the patent, at least 5 %mol % of acrylic acid or methacrylic acid groups in the polymer contain at least 5 mol 5 of these monomers in its

structures (see abstract). The starting polymers of acrylic acid or methacrylic acid are prepared by the homo- or copolymerization of either acrylic acid or methacrylic acid (col 1, lines 52-54). By contrast newly presented Claim 14 of the present case which claims a (meth)acrylic acid copolymer which is obtainable by the process of claim 9, is such that the sulfoalkylamide structure units are randomly distributed in the (meth)acrylic acid copolymer. It is significant in this context that Fong et al does not disclose that the starting acrylic acid and methacrylic acid polymers are obtained by free-radical polymerization.

Another important distinction is that as claimed in Claim 14, the molar ratio of monomers in polymer I to aminoalkylsulfonic acid ranges from 15:1 to 2:1. On the other hand, Fong et al does not disclose a specific ratio between monomers that are present in the starting polymer and aminoalkylsulfonic acid which is added during the reaction. Moreover, Example 1 of Fong et al discloses polyacrylic acid that has a Mw of 49600 (corresponds to 688 mol of acrylic acid). Taurine (7.62 g, 0.061 mol) is added to the polyacrylic acid. The ratio of monomers present in the starting polymers and amounts of taurine in Examples 2-5 are nearly the same as in Example 1. Therefore, the ratio between monomers present in the starting polymer and of aminoalkylsulfonic acid is in accordance to Example 1. Accordingly, Fong et al does not disclose a (meth)acrylic acid copolymer in which the molar ratio of monomers in the starting polymer to aminoalkylsulfonic acid ranges from 15:1 to 2:1.

Another distinction of the invention over Fong et al is that the sulfoalkylamide structural units of the (meth)acrylic acid copolymer of the invention are randomly distributed in the present copolymer. Fong et al does not show or suggest such a random distribution. Accordingly, Fong et al does not anticipate the invention as claimed in Claims 4 and 5. Withdrawal of the rejection is respectfully requested.

Claims 4 and 5 stand rejected based on 35 USC 102(b) as anticipated by Hirsch et al, U. S. Patent 4,450,013. This ground of rejection is respectfully traversed.

Hirsch et al discloses compositions that are useful as auxiliaries for the grinding of pigments and as dispersing agents for pigments. The compositions are essentially copolymers that are based on acrylic acid, methacrylic acid and sulfonic acid groups containing monomers such as 2-acrylamido-2-methylpropane sulfonic acid. The polymers are prepared by the copolymerization of monomer mixtures in isopropanol or solvent mixtures of water and isopropanol that contain at least 40 % by wt of isopropanol and temperatures of 95° to 180° C under pressure. The examples of columns 5 and 6 are prepared by free-radical polymerization of acrylic acid and 2-acrylamido-2-methylpropane sulfonic acid. The copolymer of present Claim 14 differs from that of Hirsch et al by virtue of the process claimed in Claim 9 with the result that the sulfoalkylamide structural units are randomly distributed in the (meth)acrylic acid copolymer.

The copolymers described in Hirsch et al are prepared by copolymerization of acrylic acid and/or methacrylic acid (40 to 90 % by wt) and a sulfo(meth)acrylamide compound of formula (I) (10 to 60 % by wt). The copolymerization of acrylic acid and/or methacrylic acid and highly reactive acrylamidoalkylsulfonic acids does not result in copolymers, in which the sulfoalkylamide structural units are randomly distributed in the (meth)acrylic acid copolymer, because the homopolymerization reaction of sulfoalkylamide monomers is much faster than the copolymerization reaction between acrylic acid and/or methacrylic acid and sulfoalkylamide monomers. Therefore, the homopolymerization of sulfoalkylamide monomers is kinetically preferred in comparison to the copolymerization of the two groups of monomers, which would be necessary to obtain a copolymer in which the sulfoalkylamide monomers are randomly distributed.

The present copolymer stands in contrast to that of Hirsch et al through its means of preparation by a two-step procedure, of which the first step is free-radical polymerization of (meth)acrylic acid, resulting in polymer I, and a second step (II) of amidation of the polymer

I that results from the first step (I) by reaction with at least one aminoalkylsulfonic acid. On the other hand, the polymer-analogous reaction results in a (meth)acrylic acid copolymer comprising aminoalkylsulfonic acid comonomer units, which are distributed randomly in this copolymer. Each carboxy group in the starting polymer of (meth)acrylic acid is as reactive as the neighboring carboxy group. No differences in reactivity of the carboxy groups in the starting polymer are shown. Therefore, the aminoalkylsulfonic acid randomly reacts with one carboxy group or with another one. By the random reaction, a copolymer is obtained, in which the sulfoalkylamide units are randomly distributed in the copolymer. However, as to Hirsch et al, a copolymer is disclosed in which the sulfoalkylamide units are not randomly disposed in the polymer, but a polymer in which there is present a large block of sulfoalkylamide units. The reference does not anticipate the present invention and withdrawal of the rejection is respectfully requested.

Claims 4 to 8 stand rejected based on 35 USC 102(b) as anticipated by Amick et al, U. S. Patent 4,711,725. This ground of rejection is respectfully traversed.

Amick et al discloses a method for stabilizing aqueous systems by adding to such systems an effective amount of selected low molecular weight, water-soluble polymers that contain about 10 to 84 % by wt (meth)acrylic acid units, 11 to 40 % by wt acrylamidoalkyl or aryl sulfonate units and about 5 to about 50 % by wt of at least one unit selected from vinyl esters, vinyl acetate and substituted acrylamides. Terpolymers and interpolymers can be produced that are obtained from at least three types of monomers: (I) (meth)acrylic acids and salts, (II) acrylamidoalkyl or aryl sulfonates and (III) at least one unit derived from certain vinyl esters, vinyl acetate and substituted acrylamides. The copolymers of the patent are prepared by copolymerization of the monomers in the presence of free radical initiators. However, the sulfoalkylamide structural units are not randomly distributed in the copolymer, because in the patent, the homopolymerization of acrylamide or aryl sulfonates will occur and

copolymers will be obtained, in which these monomers are not randomly distributed, but which are present in one block. This is caused by the homopolymerization reaction which is preferred in contrast to copolymerization with other monomers in the mixture. Thus, the copolymer of the patent does not contain randomly distributed sulfoalkylamide structural units. Withdrawal of the rejection is respectfully requested.

Claims 4, 5, 7 and 8 stand rejected based on 35 USC 102(b) as anticipated by Lange et al, U. S. Patent 3,898,037. This ground of rejection is respectfully traversed.

Lange et al discloses (co)polymers of acrylamido-sulfonic acid compounds and their use basically as dispersants for particles that are present in aqueous systems (abstract). (Meth)acrylic acid sulfoalkylamides are copolymerized with, for example, acrylic acid and methacrylic acid (col 4, line 48 to col 5, line 36). The copolymers are obtained by a free-radically initiated copolymerization reaction. Such a reaction, as mentioned above in the discussions of the Hirsch et al and Amick et al patents, which employ very reactive sulfoalkylamide monomers and (meth)acrylic acid monomers does not result in copolymers in which the sulfoalkylamide structural units are randomly distributed in the (meth)acrylic acid copolymer, as claimed in Claim 14. Therefore, Lange et al does not disclose the (meth)acrylic acid copolymers of the present invention.

Claims 1-3 stand rejected based on 35 USC 103(a) as anticipated by Fong et al, U. S. Patent 4,604,431 in view of Muenster et al, U.S. Patent 4,301,266. This ground of rejection is respectfully traversed.

As is clear from the discussion above concerning Fong et al, the same does not disclose a starting polymer of acrylic acid or methacrylic acid that is prepared by a free-radically initiated reaction therefore does not disclose a polymer product in which sulfoalkylamide units are randomly located within the polymer. It further does not disclose a

polymer I in which the molar ratio of monomers to aminoalkylsulfonic acid ranges from 15:1 to 2:1.

Turning to the Munster et al patent, the same discloses polymers of acrylic acid or methacrylic acid that are prepared by free-radical polymerization, initiated by conventional free-radical polymerization catalysts such as hydrogen peroxide or potassium or sodium peroxydisulfate, organic initiators such as benzoylperoxide and bisazodiisobutyronitrile and the like (col 2, lines 7 to 14). Munster et al does not disclose a starting polymer that is prepared by the polymerization of acrylic acid or methacrylic acid with at least one aminoalkylsulfonic acid, under conditions wherein the molar ratio of monomers in polymer I to aminoalkylsulfonic acid ranges from 15:1 to 2:1.

As mentioned above, Fong et al discloses a polymer-analogous reaction of a starting polymer and at least one aminoalkylsulfonic acid which is used in a ratio of 688/1 mol acrylic acid/aminosulfonic acid. Applicants submit that one of skill in the art would not be led by Fong et al to conduct the process of present Claim 9, because none of the cited documents discloses or suggests that the very specific molar ratio of monomers in the starting polymer to aminoslkylsulfonic acid should be as low as 15:1 to 2:1 in order to obtain (meth)acrylic acid copolymers which can very advantageously be used to treat water, inhibit scale formation in petroleum production and/or inhibit corrosion in aqueous systems.

Applicants submit that the disclosure of the present specification supports the patentable distinction of the present invention. The advantageous characteristics of the copolymers obtained by the process of Claim 9 are described on pages 10 to 15 of the text. Pages 11 and 12 shows the effectiveness of the present polymer as an agent which inhibits deposition of calcium phosphate and calcium phosphonate. Further, from the table on page 12 of the description it can be seen that the taurine-modified polymer of the invention exhibits a very high inhibition of 90 % at a very low dosage of only 15 ppm, whereas the transamidated

polymer, which is not within the scope of the present claims has an inhibition of 38 % at this dosage. Moreover, the table on page 14 shows that calcium phosphonate inhibition can be achieved with a value of 68 % at a dosage of only 10 ppm, whereas the transamidated polymer, prepared by a process not within the scope of the present process has an inhibition value of only 53 %. The inhibition levels at dosages of 20 or 30 ppm are both higher for the taurine modified polymer of the invention in comparison to the transamidated polymer of the art. Accordingly, applicants submit that the presently claimed process is patentably distinguished over the cited and applied references and withdrawal of the rejection is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

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